OUR ASTRONOMICAL COLUMN.

EPHEMERIS FOR OBSERVATIONS OF EROS:—

1900.	R.A.	Decl.
	h. m. s.	° ′ ″
Oct. 25 ...	2 27 27·35 ...	+52 36 52·0
26 ...	25 52·13 ...	52 49 53·2
27 ...	24 13·05 ...	53 2 9·2
28 ...	22 30·39 ...	53 13 38·2
29 ...	20 44·30 ...	53 24 18·5
30 ...	18 55·10 ...	53 34 8·5
31 ...	17 2·99 ...	53 43 6·5
Nov. 1 ...	2 15 8·32 ...	+53 51 11·3

OPPOSITION OF EROS.—M. Loewy has distributed a fifth circular containing additional information intended to secure uniformity of observation among the many institutions which have now commenced their work of determining the parallax of Eros. It is advised that the positions relative to neighbouring stars be measured in rectangular co-ordinates, and also that the eleventh magnitude be adopted as the inferior limit of brightness for the comparison stars. For those undertaking photographic determinations, it is recommended—

(1) That on each plate there be made two exposures of different length, so that each star may be recorded by two images some twenty seconds of arc apart in declination. This procedure will fulfil the two functions of eliminating spurious stars, and of enabling two series of measures to be made on star-discs of very different diameters, so that the photographic spreading effect may be allowed for to some extent. For instruments of the type employed for the international chart (0·33 metre aperture), exposures of six and three minutes are recommended.

(2) On the plates especially for the planet's position, two exposures should also be made, one while the guiding star is accurately followed, the other keeping the planet on the cross wires, or if this be too difficult on account of its faintness, the guide star should be given a motion equal, and in the contrary direction to that of the planet. The result of these operations will be two images of Eros, one showing as a short faint line, the other as a circular patch. This is now known to be quite possible, as the planet has recently been photographed, October 4 and 6, both at Paris and Algiers, in three minutes, the magnitude being estimated at 10·5. Prof. Joly also states that with the 15-inch reflector at Dublin, images were obtained with exposures of six and two minutes.

Another list of comparison stars is provided, and the ephemeris extended to March 1901. The brightness of Eros is now slowly increasing, being 9·81 magnitude on October 29, reaching its maximum of 9·02 on December 18, and then decreasing to 10·48 in March at the close of the time of these special observations. M. Loewy asks all collaborating in the enterprise to forward regularly the successive progress made in the various sections.

NEW DOUBLE STARS.—In the *Astronomische Nachrichten* (Bd. 153, No. 3668), Mr. R. G. Aitken gives the particulars relating to 62 new double stars discovered by him with the 12-inch equatorial of the Lick Observatory. This list is supplementary to that previously published in *Astronomische Nachrichten*, No. 3635. Each star after discovery has been measured with the 36-inch telescope on at least one night; 39 of the pairs are under 2″ distance, 24 under 1″, and twelve under 0″·5. The list has been checked by comparison with Prof. Burnham's General Catalogue of Double Stars.

ASTRONOMICAL WORK AT DARAMONA OBSERVATORY.—We are in receipt of an interesting volume from Mr. W. E. Wilson, containing reprints of the astronomical and physical researches made at his observatory at Daramona, Westmeath, since 1892. Mr. Wilson started in 1871 with a 12-inch equatorial, by Grubb, but did little more with this instrument than lunar photography with wet plates and determinations of solar radiation. In 1881, however, he built the present large observatory attached to the house, and installed therein a new 24-inch silver-on-glass mirror of 10 feet 6 inches focus. The old 12-inch mounting proving too light for the extra load, it was replaced in 1892 by one of the best pattern with Grubb driving clock and electrical control. In 1889, an additional laboratory was added for the physical investigations which have formed so large a portion of the observer's programme.

The purely astronomical work with the 24-inch has practically been confined to the photography of star clusters and nebulæ. Very beautiful reproductions in collotype of some of these are included at the end of the volume.

The astrophysical portions deal with experimental investigations on the heat of the sun, absorption of heat in the solar atmospheres, thermal radiation of sun (both photosphere and spots) and electrical measurement of starlight.

HISTORICAL ASPECTS OF THE DISCOVERY OF THE CIRCULATION OF THE BLOOD.[1]

THE discovery of the circulation of the blood by William Harvey is commonly regarded among scientific discoveries as eminent if not unique; and this in the judgment not of Englishmen only. My purpose to-day is to show that at any rate it was made against enormous difficulties.

To put this discovery in right perspective we must have some vision of the history of philosophy, science and medicine. Medicine, herein in contrast with Theology and Law, had its sources almost wholly in the Greeks; from them for good or evil it took its first scheme of thought; and in the schools of Hippocrates and of Alexandria it was based, more soundly, on natural history and anatomy. The noble figure of Galen, the first physiologist and the last of the great Greek physicians, portrayed for us by Dr. Payne in the Harveian Oration of 1896, stood eminent upon the brow of the abyss when, as if by some convulsion of nature, Medicine was overwhelmed for fifteen centuries. Galen practised the method of verification by experiment, first introduced perhaps by Archimedes, but after him it was lost till the time of Gilbert, Galileo and Harvey.

In the growth of societies small civilisations have been sacrificed to the formation of larger aggregates, whereby stable equilibrium may be attained for the highest ends. Perhaps because of her very freedom of thought Greece never became a nation. Even the Roman peace, bought as it was at the cost of learning and the arts, was but a mechanical peace. In the wilder regions of the empire the bodies but not the wills, of men were in subjugation, and even in Rome itself the sanction of patriotism was failing. Under the Frankish invasion the very traditions of learning and obedience seemed to be broken up. Then Europe was saved by the inspiration of the Christian religion which, entering as a new element into the ancient fabric of Roman empire, was now to hold men's service in heart and soul as well as in body; but to this end no mere mystic or personal religion could suffice; clothing itself with the political and ritual pride, and even with the mythology of the pagan empire, it inspired a new adoration; but it imposed upon men also a universal and elaborated creed. In the third century philosophy was born again in neo-platonism, the offspring of the coition of East and West in Alexandria, where all religions and all philosophies met. The world and the flesh were crucified that by the spirit man might enter into God. Pure in its ethical mood, neo-platonism, says Harnack, led surely to intellectual bankruptcy; the irruption of the barbarians was not altogether the cause of the eclipse of natural knowledge. Yet even then, as again and again, the genius of Aristotle came to save the human mind. Proclus, ascetic as he was, was also versed in Aristotle; he compelled the Eastern mysteries into peripatetic categories, and bequeathed a formal philosophy to the faith. Thus the first Scholastic period was fashioned, and the objects and methods of inquiry were determined for thirty generations. Rationalised dogma lived upon dialectic, and conflicted with mysticism; but logic, dogma and mysticism alike disdained experience. The Faith, then, was the first adversary of Copernicus, Galileo and Harvey.

It was the fortune of the Faith that, of all the treatises of Plato, the Timæus, the most fantastic and least scientific, should have survived to instruct the mediæval world; while those works of Aristotle which might have made for natural knowledge fell out of men's hands: moreover, the Categories and the "Interpretation" made for more than Aristotelian nominalism, and turned men's minds rather to rhetoric and dialectic than to natural science. Thus Plato's chimæra of the human microcosm, a reflection of his theory of the macrocosm, stood beside the Faith as the second great adversary of physiology.

The influence of authority, whereby Europe was to be welded together, penetrated into all human ideas. As was

[1] Abstract of the Harveian Oration of 1900, delivered by Prof. Clifford Allbutt, F.R.S.

the authority of the Faith, so was that of Plato; and, in the second period of the Middle Ages, of the Arabian versions of Aristotle and Galen. It is not easy for us to realise a time when intellectual progress, which involves the successive abandonment of provisional syntheses, was unconceived; when truths were regarded as absolute; when reasons were not tested but counted; when even Averroists found final answers either in Aristotle or in Galen. Thus in the irony of things was Harvey withstood by the dogma of that Galen who, in his own day, had earnestly appealed from dogma to nature.

In the Isagoge of Porphyry is set forth distinctly a problem, which during the Middle Ages rent Western Europe asunder; a problem, says John of Salisbury, which engaged more of the time and passions of men than for the house of Cæsar to conquer and govern the world; a problem, indeed, which in our own day is not wholly resolved. This was the controversy of the Realists and Nominalists, first brought to a clear issue by William of Champeaux and Roscellinus respectively. Now Plato held ideas not as mere abstractions but as creative forces; and we shall see how potent was this function in mediæval thought. Every particular, every thing, was regarded by the realist as the product of universal matter and individual form. Now form might be regarded, and variously was regarded, as a shaping, determinative force or principle, pattern or mould, having a real existence apart from stuff; or, on the other hand, as an abstract principle or pattern having no existence but as a conception of the mind of the observer. And for the Realist, not individuals only, but genera and species also have their forms; either pre-existent (*universalia ante rem*) or continuously evolved in the several acts of creation (*universalia in re*). For instance, the Church for the Realist is a thing apart from the wills of successive generations of individual men; Man has fallen, not only in many or all individual cases, but also as a kind—a kind having an independent existence; in the Sacraments again there may be a change of hypostasis without change in sensible matter. Now, if forms pre-exist (*ante rem*), the will of God must be predetermined; or if form be an immanent function acting in *re*, we are landed in pantheism. Thus Erigena, the brilliant prophet and protestant of the first period of the scholastic philosophy, was virtually a pantheist, as Spinoza was the last great realist. Aquinas, who determined the philosophy now ruling in Rome, brought about a compromise, which covers up rather than solves the difficulty. The problem, it is evident, was no hair-splitting; it dealt with the very nature and origin of being, and it agitated the minds of earnest men at a time of fervid and widespread enthusiasm for knowledge.

Now closely allied to the argument concerning universals was that concerning "matter and form." Whether the terms used were "form and matter," "force, energy or pneuma and matter," "soul, archæus or life and body," "determinative essence and determinate subsistence," "male principle and female element," "the potter and the clay of the potter"; or whether again they were "effect and cause," "nature and law," "being and becoming," the riddle lay in the contrast of the static and dynamic aspects of things; in the incessant formation of variable individuals in the eternal ocean of existence. Even Francis Bacon never got out of the tangle of Form, Cause and Law. It has been the temptation of philosophers of all times, and even of Harvey himself, than whom none had put better the conditions of scientific method, to suppose that by means of abstraction kinds may be apprehended; that thus they may get nearer to the inmost core of things; that by purging away the characters of individuals they may detect the essence and the cause of individuation; not perceiving that the content of notions is indeed in inverse proportion to their universality. We see this error continually to-day. For instance, we may discuss the causes of typhoid fever, and bewilder ourselves by forgetting that there is no such thing as typhoid fever, and that the only causes of a general notion are the psychological causes of its generation in the mind of the thinker at the time; that which is due to objective causes is of course not the notion, but the particular case—a very different affair.

Before motionless stuff—before the problem of the "primum mobile," even Harvey himself, when he had come to the end of his admirable experiments and began to indulge in contemplation, stood helpless. In his need for a motor for his machine he was not able to divest himself of the language nor even of the philosophy of his day. In his day he could not help regarding rest and motion as different things, and motion as a superadded quality. The motion he attributes, not to a property of the heart, but of the blood—to its "innate heat," which is as far as he could possibly have got. But, by way of explanation, he adds that the innate heat of the blood "is not fire, nor derived from fire"; nor is the blood occupied by a spirit, but is a spirit; it is also "celestial in nature, the soul, that which answers to the essence of the stars . . . is something analogous to heaven, the instrument of heaven." In denying that a spirit descends and stows itself in the blood or elsewhere, as an "extraneous inmate," he bravely says: "I cannot discover this spirit with my senses, nor any seat of it"; and yet, in the treatise "De Generatione," he propounds a theory of the impregnation of the female, not by any material from the male, but by the influence upon her of a "general immaterial idea"; which, even for his own time, was very substantial realism. The riddle which oppressed the great thinkers, from the Greeks to Lavoisier, was, then, the nature of the "Bildungstrieb"—of the "impetum faciens." What makes the ball to roll? Does heart move blood, or blood move heart? and, in either case, what bestows and perpetuates the motion? Telesius, the first of the brilliant band of natural philosophers in Italy of the sixteenth and seventeenth centuries, still sought this principle of nature in the "form" of the peripatetics. Gilbert regarded his magnetic force as "of the nature of soul, surpassing the soul of man." Galileo, although willing to conceive circular motion as perpetual, and even self-existent, was unable thus to conceive rectilineal motion. All these naturalists, including Harvey, and even Descartes, followed the mediæval world and Aristotle in deriving the source of motion directly from that of the spheres—from the quintessence (*vid.* Arist. De Coelo; and Met. xii.). Till Copernicus transfigured the cosmos, and Galileo and Newton carried terrestrial physics into the celestial worlds, the heavenly bodies were regarded as animated beings, themselves active, and, by propagation from sphere to sphere, animating all "sublunary" matter, wheels within wheels, even to its innermost particles.

Of the origin of energy we have not solved the riddle; we have given it up; but instead of finding its sources without we find them within. Harvey's contemporary, Francis Bacon, sagaciously guessed that heat is an expansive motion of particles; but he regarded heat and cold as two contrary principles. Almost in the same generation the brilliant John Mayow perceived a substance in the air "allied to saltpetre," which passed in and out of the blood by the way of the lungs or placenta. So innate heat gave way to phlogiston, and soon afterwards oxygen and the conservation of energy turned out to be the "form" "spirit," "essence," "primum mobile," "causa efficiens," "potentiality," and the rest of them; so by Lavoisier, a vast pile of metaphysics was blown into the air. But to kill a strong theory outright takes many a generation; realism, shaken by Abelard, and scotched by Hales and Ockham, not only survived to mislead Harvey, but it stretches its withered hand over us still—in the nursery, in the schoolroom, in the university, and in the great arguments of life.[1]

As strong as realism was a third adversity—the pride of the human mind. The asceticism derived from the East, disdainful of carnal things, brought the dualism of matter and spirit into monstrous eminence; and in respect of medicine, in a few generations it turned the cleanest people in the world into the most filthy.[2] Almost to this day the mechanical arts, presumably concerned with lower categories, have been regarded as base; and the crafts, even of the laboratory, as unworthy of great souls.

Anatomy had to labour also against both ecclesiastical and popular antipathy; chemistry and mechanics were gross pursuits unless endowed with the perilous distinction of alchemy and sorcery. Unfortunately, this charge upon the dignity of man was made heavier rather than lighter by Petrarch and the humanists of the Renascence; and in Oxford of the seventeenth century we find that Boyle was bantered by his friends as one "given up to base and mechanical pursuits." In a certain important respect medicine suffered greatly from this prejudice. It is obvious that, speaking generally, medicine would find its most positive and direct control in those diseases and in those

[1] The readers of NATURE know how effectively this mischievous survival has been attacked recently by Prof. Perry, Mr. Heaviside and other contributors. But even greater men, whose blows still resound through the centuries, have attacked it in vain.

[2] Those curious in such things will notice that the mediævalising clergy of our own day have discarded in their persons that fair linen which in their fathers was the emblem and example of cleanliness.

therapeutical experiments which are manifest on the outside of the body. Yet surgery fell under the proscription of a handicraft, and as such was eliminated from the colleges of physicians both in London and Paris. Thus the genuine work of such men as Paré and Gale were without influence upon medicine, and thus it came about that Francis Bacon said of the physicians of Harvey's day that they saw things from afar off, as if from a high tower. From Erasistratus to Celsus, physicians practised medicine as one art. Galen taught, not the simplicity, but the unity of medicine; and Littré points out that this unity is consistent in the Hippocratic writings. Surgery, by virtue of its imperative methods, was kept clear of philosophy on the one hand and of humanism on the other. Fortunately for Harvey, his master, Fabricius, was as great a surgeon as anatomist; and such was Fallopius. Thus it was that medicine, at the end of the Middle Ages, had not recovered the standard of Alexandria. And against this adversity, also, had the founder of physiology to contend.

Happily the Arabian scholastic philosophy took its root in Alexandria when neo-platonism had veered towards Aristotle, and it was therefore more uniformly peripatetic than the Christian scholasticism. It is one of the signs of the greatness of Aristotle that, thus garbled and glossed, his power made itself felt in the thirteenth century, chiefly by the great Franciscans Alexander Hales, Roger Bacon, and William Ockham—Roger Bacon, whom we may call the first of the natural philosophers of the West. This former renascence determined the second period of the Middle Ages: the period distinguished by the Arabian version of Aristotle, by a check to the chimæras of realism, by some liberty of secular knowledge—for even bishops came out of the school of Toledo—and again by the coming of the Friars, whose influence upon the thought of the Middle Ages was a curious proof that, as all ways are said to lead to Rome, so all systems of thought, in spite of the thinkers, led to natural science. The logic and rhetoric of the Dominicans, by their rationalism, defined, and in defining restricted, the dominion of the Faith. Men got used to reason, and made a language for thought. And in the history of the unlearned Friars Minors we find, as elsewhere in history, that mysticism is more favourable to natural knowledge than the passionate dogmatism of Clairvaux or the dogmatic rationalism of St. Thomas. The Victorians, as Gerson after them, despised reason rather than feared it; mysticism makes for individual religion, as in Glisson and Newton, rather than for the Church. Hence it may have been that independent thinkers, like Hales and Bacon and Ockham, entered the Franciscan Order. The former renascence bred also a more tolerant spirit. Albert of Cologne owed as much to Avicenna as St. Thomas to Averroes: sages technically damnable, yet "mighty spirits," worthy of reverence. Dante put in hell, but on green meadows, in an open place, lofty and luminous, not only Aristotle, Plato and Socrates, but also Euclid, Ptolemy, Hippocrates, Avicenna, Galen and "Averroes who made the great commentary." Universities were founded in France, England and Italy. But the natural science which made the second renascence irresistible was absent from the former; and at the end of the century a reaction set in. During the two following centuries in Spain freedom of thought was crushed out by the Church; but in the conflagration of books of philosophy, medical works, such as the "Colliget" and the Commentary on Galen of Averroes, were largely spared; yet in the fourteenth and fifteenth centuries the very name of Averroes, "the mad dog that barked against the Christ," not only became ecclesiastically accursed, but also began to signify loose life as well as free thought; a resentment of which there was no trace in Albert or Aquinas.

Averroism, however, held its ground at Padua, which had become celebrated for medicine as Bologna for law; and although Averroism, like any other philosophy taught as a separate study, decayed, yet, effete as it was, it kept the ground open at a time when the tide was turning against free thought; when the commercial supremacy of Venice was declining, when the Spanish Inquisition was established in Rome, and when even the influence of the Florentine humanists was rather against natural knowledge than for it. No doubt the coarse and disingenuous scepticism of the physicians of North Italy and their pretentious manners alienated the humanists, not only from themselves, but also from natural philosophers such as Telesius and Galileo; and Averroists and humanists alike stood by at the burning of Bruno. Harvey entered Padua at a fortunate time; he found Galileo engaged in teaching, and also in methodical research; and Galileo was not only a great discoverer, but was the first to formulate fully and clearly that method which we know under the name of the inductive method. The discovery of Greek texts had destroyed the conventional Aristotle and the conventional Galen; Gregory, by the reform of the calendar, had put the axe to the root of astrology; Newton was soon to carry terrestrial physics into celestial spheres; and Boyle was soon to create chemistry; while anatomy was fully awake already. In England, moreover, with the accession of Elizabeth more spacious times were assured, and Charles protected Harvey. Clinical teaching had been established at Padua by Fracastorius and Montanus, to be pursued in Heidelberg, Leyden and Vienna. Physiology, however, awaited Harvey. Servetus had buried his conception of the lesser circulation under a pile of theology; Columbo and Fabricius had prepared the way, not so much by the value of their discoveries as by their practice of the experimental method in this science; for the anatomists, Galenists to a man, had done next to nothing for physiology.

The genius and courage required to make discoveries like that of the circulation of the blood cannot be measured directly; there is no method of determining the specific gravity of such adventures; I have tried, however, to shadow forth the weight of the social systems, opinions, prejudices and habits against which Harvey's gigantic effort was made. Almost in the year of the publication of the "De Motu Cordis" (A.D. 1628), the Parliament of Paris issued an edict that no teacher shall promulgate anything contrary to the accepted doctrines of the ancients. Under such conventions Harvey's discovery burst like an earthquake; under corrupt Galenism, venerable sophistries, current abstractions bequeathed by realism, and long-winded dialectics on critical days, coctions, derivatives or revulsives, and dogmas based on uncritical subservience to texts. His work stood out even more ascendant against a lurid background of folk superstitions—of vampyres, witch-burning, magic, cabbalism, astrology, alchemy, chiromancy and water-casting. In terrestrial and celestial physics, Galileo, persecuted as he was, had some strong current with him; Copernicus was before him, Kepler was beside him: but in physiology upon the path of Galen the waters had closed as upon the track of a great ship, and among Harvey's contemporaries and immediate forerunners there was none to claim a share with him in the discovery of the central fact of physiology, or in his application of the method which opened the way to Pecquet, Glisson, Steno, Wharton, Willis, Haller and Bernard.

THE ANNUAL CONGRESS OF THE GERMAN ANTHROPOLOGICAL SOCIETY.

THE thirty-first Congress of the German Anthropological Society was held in the University town of Halle from September 24–27. In addition to its rich University collections, a special interest is attached to Halle as being the seat of the oldest German society for encouraging the study of natural science, viz. the Leopoldina-Carolina Academy, which is thus comparable to the Royal Society in this country. To students of prehistoric archæology, the Prussian province of Saxony is chiefly interesting from the fact of the existence of copper-mines at Eisleben, some little distance from Halle. The meetings were held under the presidency of Prof. Virchow, assisted by Prof. Ranke. At the opening session on Monday, September 24, the presidential address (dealing with the general progress of anthropological study and teaching) was followed by a series of addresses from representatives of the University and town of Halle, of which that of the local secretary, Dr. Förtsch, is particularly noteworthy as containing a sketch of local prehistoric archæology, a field of research in which Dr. Förtsch has been particularly active, and which he has popularised with evident success. Of the subsequent communications to the Congress, the majority of which dealt with archæology, there appear to us most worthy of mention the discussion opened by Prof. Virchow on the "Earliest appearance of the Slavs in Germany," and the account (illustrated with excellent lantern slides) given by Dr. Birkner (Munich) of the investigation of the graves of the German Emperors in Speyer. Prof. v. Fritzsch (Halle) and Dr. Lehmann-Nitzsche (La Plata) rendered interesting accounts of discoveries of prehistoric man in Thüringia and in the Argentine respectively, the latter record